EP 501: Homework #1
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```
% EP 501 Homework 1 Main
% Julio Guardado

clear;
clc; close
all;
```

Problem 1.a + 1.b

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%') disp('Problem 1 Part a+b:')

%load test problem
load testproblem.mat

%used simple elimination function
Amod = forward_elim(A,b);

%test function with built in matlab functions and provided backsub.m
test_ans = A\b; answer = backsub(Amod);

%display   solution   fprintf('\tMATLAB:\t
forward_elim.m:\n')
disp(cat(2,test_ans,answer))

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%
Problem 1 Part a+b:
 MATLAB:    forward_elim.m:
    1.0000    1.0000
    2.0000    2.0000
    3.0000    3.0000
    4.0000    4.0000
    5.0000    5.0000
    6.0000    6.0000
    7.0000    7.0000
    8.0000    8.0000
```

Problem 1.c

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%') disp('Problem 1 Part c+d:')

%load test problem load
lowertriang_testproblem.mat

%solve using matlab built in func
test_ans = L\bL;

%solve using forwardsub func answer
= forwardsub_lt(L,bL);

%display    solution    %display    solution
fprintf('\tMATLAB:\t  forward_sub.lt.m:\n')
disp(cat(2,test_ans,answer))
```

%%%
%%%%%%%%%%%%%
Problem 1 Part c+d:
MATLAB: forward_sub.lt.m:
*   1.0000   1.0000*
*   3.0000   3.0000*
*   5.0000   5.0000*
*   7.0000   7.0000*
*   9.0000   9.0000*
*   11.0000   11.0000*
*   13.0000   13.0000*
*   15.0000   15.0000*

Problem 2

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%') disp('Problem 2:')

%load test problem
load testproblem.mat

%solve using matlab built in func
test_ans = inv(A);

%solve using forwardsub func
[~, invA] = GJ_elim(A,eye(8));

%display solution

disp('Solution from built in MATLAB function:')
disp(test_ans) disp('Solution from GJ_elim.m:')
disp(invA)
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%
Problem 2:
Solution from built in MATLAB function:
  Columns 1 through 7

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305
   -0.0697   -0.5582   -0.4000   -1.3059    0.0704    0.6537    0.8908
    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503

  Column 8

    0.2581
    0.2324
    0.3873
    0.2608
    0.6467
   -0.6463
   -0.7433
    0.0735

Solution from GJ_elim.m:
  Columns 1 through 7

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305
   -0.0697   -0.5582   -0.4000   -1.3059    0.0704    0.6537    0.8908
    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503

  Column 8

    0.2581
    0.2324
    0.3873
    0.2608
    0.6467
   -0.6463
   -0.7433
    0.0735
```

Problem 3.a-c

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%') disp('Problem 3.a-c:')

%load test problem
load testproblem.mat

%perform Doolittle LU factorization
[L, U,X] = DLU_fact(A,cat(2,b,b2,b3));

%display solution of first b matrix
disp('Solution of test problem from L and U:')
disp(X(:,1))

%display solution of multiple right hand sides
disp('Solution of multiple right hand sides from L and U:')
disp(X)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%
Problem 3.a-c:
Solution of test problem from L and U:
    1.0000
    2.0000
    3.0000
    4.0000
    5.0000
    6.0000
    7.0000
    8.0000

Solution of multiple right hand sides from L and U:
    1.0000     2.0000    10.0000
    2.0000     4.0000    20.0000
    3.0000     6.0000    30.0000
    4.0000     8.0000    40.0000
    5.0000    10.0000    50.0000
    6.0000    12.0000    60.0000
    7.0000    14.0000    70.0000
    8.0000    16.0000    80.0000
```

Problem 3.d

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%') disp('Problem 3.d:')

%solve using matlab built in func
test_ans = inv(A);

%solve using LU Factorization [~,~,X]
= DLU_fact(A,eye(size(A,1)));

disp('Solution from built in MATLAB function:')
disp(test_ans) disp('Solution from Doolittle LU
factorization:') disp(X)
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%
Problem 3.d:
Solution from built in MATLAB function:
  Columns 1 through 7

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305
   -0.0697   -0.5582   -0.4000   -1.3059    0.0704    0.6537    0.8908
    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503

  Column 8

    0.2581
    0.2324
    0.3873
    0.2608
    0.6467
   -0.6463
   -0.7433
    0.0735

Solution from Doolittle LU factorization:
  Columns 1 through 7

   -0.4480    0.3835    0.0281   -0.0881   -0.5795    1.0474   -0.5356
   -0.0540   -0.1948   -0.2456   -0.6264    0.1978   -0.2692    0.2222
    0.2062   -0.1064   -0.3766   -1.1154   -0.0220    0.5605    0.2837
   -0.3250    0.4251    0.0724   -0.1670   -0.3128    0.8816    0.4305
   -0.0697   -0.5582   -0.4000   -1.3059    0.0704    0.6537    0.8908
    0.3565    0.3345    0.1079   -0.1491    0.2014    0.0363   -0.2920
   -0.1222    0.1436    0.0008    0.7677   -0.2421   -0.0132   -0.1231
    0.1043   -0.2818   -0.2839   -0.2878    0.4281   -0.1212    0.1503
```

0.2581
0.2324
0.3873
0.2608
0.6467
−0.6463
−0.7433
0.0735

Problem 4

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%') disp('Problem 4:')

%load test problem load
iterative_testproblem.mat

%set up nit =
size(Ait,1);
x0=randn(nit,1);
tol=1e-9; omega =
1;

%solve using matlab built in func
test_ans = Ait\bit;

%solve using Successive over relaxation
[xit,nit] = SOR(x0,Ait,bit,tol,omega);

%display                  solution
fprintf('\tMATLAB:\t  SOR.m:\n')
disp(cat(2,test_ans,xit))
```

%%%
%%%%%%%%%%%%
Problem 4:
 MATLAB: SOR.m:
    0.0329   0.0329
    0.1316   0.1316
    0.2400   0.2400
    0.3375   0.3375
    0.4142   0.4142
    0.4642   0.4642
    0.4839   0.4839
    0.4720   0.4720
    0.4293   0.4293
    0.3584   0.3584
    0.2641   0.2641

```
 0.1526    0.1526
 0.0310    0.0310
-0.0926   -0.0926
-0.2101   -0.2101
-0.3138   -0.3138
-0.3971   -0.3971
-0.4544   -0.4544
-0.4819   -0.4819
-0.4780   -0.4780
-0.4427   -0.4427
-0.3785   -0.3785
-0.2896   -0.2896
-0.1817   -0.1817
-0.0619   -0.0619
 0.0619    0.0619
 0.1817    0.1817
 0.2896    0.2896
 0.3785    0.3785
 0.4427    0.4427
 0.4780    0.4780
 0.4819    0.4819
 0.4544    0.4544
 0.3971    0.3971
 0.3138    0.3138
 0.2101    0.2101
 0.0926    0.0926
-0.0310   -0.0310
-0.1526   -0.1526
-0.2641   -0.2641
-0.3584   -0.3584
-0.4293   -0.4293
-0.4720   -0.4720
-0.4839   -0.4839
-0.4642   -0.4642
-0.4142   -0.4142
-0.3375   -0.3375
-0.2400   -0.2400
-0.1316   -0.1316
-0.0329   -0.0329
```

Problem 5

```
disp('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%') disp('Problem 5:')

%load test problem
load testproblem.mat

%solve using matlab built in func
test_ans = det(A);

%solve using determintant.m
[~,determ] = Gauss_elim_det(A,b);

%display solution fprintf('Determinant calculated by MATLAB:\t\t\t
%f\n',test_ans) fprintf('Determinant calculated by
Gauss_elim_det.m,: %f\n',determ)
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%
Problem 5:
Determinant calculated by MATLAB:     -39.424745
Determinant calculated by Gauss_elim_det.m,: -39.424745
```

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